

Kenichi OGATA et al., S.N. 10/530,607  
Page 2

Dkt. 2271/74228

**Listing of Claims**

The following listing of claims will replace all prior versions, and listings, of claims in the subject application:

Claim 1 (canceled).

2. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 1 comprising:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber, along the predetermined direction, has a pressure absorbing surface with a rigidity lower than those of other wall surfaces and configured to absorb a pressure change,

wherein said pressure absorbing surface is formed by a pressure absorbing member having a non-uniform thickness, and

wherein the pressure absorbing surface is divided into a central portion and two end portions on both sides of the central portion along the predetermined direction, and an average thickness of the pressure absorbing member at the central portion is larger than an average thickness of the pressure absorbing member at the end portions.

Kenichi OGATA et al., S.N. 10/530,607  
Page 3

Dkt. 2271/74228

Claim 3 (canceled).

4. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 3 comprising:  
a plurality of nozzles for ejecting a fluid;  
a plurality of pressure-applied chambers arranged in a predetermined direction and each  
communicating with a corresponding one of the nozzles; and  
a common chamber having a plurality of wall surfaces and configured to supply the fluid  
to the pressure-applied chambers,  
wherein at least one of the wall surfaces of the common chamber, along the  
predetermined direction, has a pressure absorbing surface with a rigidity lower than those of  
other wall surfaces and configured to absorb a pressure change,  
wherein said pressure absorbing surface is formed by a pressure absorbing member  
having a non-uniform thickness,  
wherein the pressure absorbing member has a thin portion and a thick portion having at  
least two kinds of thicknesses, and  
wherein the thick portion is provided at a central portion of the pressure absorbing  
member along the predetermined direction, and the thin portion is provided on both sides of the  
central portion of the pressure absorbing member along the predetermined direction.

5. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 3 comprising:  
a plurality of nozzles for ejecting a fluid;  
a plurality of pressure-applied chambers arranged in a predetermined direction and each

Kenichi OGATA et al., S.N. 10/530,607  
Page 4

Dkt. 2271/74228

communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber, along the predetermined direction, has a pressure absorbing surface with a rigidity lower than those of other wall surfaces and configured to absorb a pressure change,

wherein said pressure absorbing surface is formed by a pressure absorbing member having a non-uniform thickness,

wherein the pressure absorbing member has a thin portion and a thick portion having at least two kinds of thicknesses, and

wherein the pressure absorbing member has a stacked structure made up of a plurality of layers, and a number of layers of the stacked structure forming the thin portion is different from a number of layers of the stacked structure forming the thick portion.

6. (currently amended) [[The]] A recording head as claimed in claim 3 comprising:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber, along the predetermined direction, has a pressure absorbing surface with a rigidity lower than those of

Kenichi OGATA et al., S.N. 10/530,607  
Page 5

Dkt. 2271/74228

other wall surfaces and configured to absorb a pressure change,

wherein said pressure absorbing surface is formed by a pressure absorbing member  
having a non-uniform thickness,

wherein the pressure absorbing member has a thin portion and a thick portion having at  
least two kinds of thicknesses, and

which wherein the recording head satisfies a relationship

$$2 \times 10^{10} < U_d^2 \times U_y^{-2.5} \times U_x^{-3.5} \times E^{2/3} < 9 \times 10^{10}$$

where  $U_d$  (m) denotes a thickness of the thin portion,  $U_y$  (m) denotes a length of the thin portion along a direction perpendicular to the predetermined direction,  $U_x$  (m) denotes a length of the thin portion 22 the predetermined direction, and  $E$  (Pa) denotes a Young's modulus of the thin portion.

7. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 1 comprising:  
a plurality of nozzles for ejecting a fluid;  
a plurality of pressure-applied chambers arranged in a predetermined direction and each  
communicating with a corresponding one of the nozzles; and  
a common chamber having a plurality of wall surfaces and configured to supply the fluid  
to the pressure-applied chambers,  
wherein at least one of the wall surfaces of the common chamber, along the  
predetermined direction, has a pressure absorbing surface with a rigidity lower than those of  
other wall surfaces and configured to absorb a pressure change,  
wherein said pressure absorbing surface is formed by a pressure absorbing member

Kenichi OGATA et al., S.N. 10/530,607  
Page 6

Dkt. 2271/74228

having a non-uniform thickness, and

wherein the pressure absorbing member has a Young's modulus of 100 MPa or greater.

8. (currently amended) The recording head as claimed in claim [[1]] 7, wherein the pressure absorbing member is made of nickel.

9. (currently amended) The recording head as claimed in claim [[3]] 4, which satisfies a relationship

$$0.25 < U_x/T_x < 0.45$$

where  $U_x$  ( $\mu\text{m}$ ) denotes a length of the thin portion along the predetermined direction X and  $T_x$  ( $\mu\text{m}$ ) denotes a total length of the pressure absorbing member along the predetermined direction.

10. (original) The recording head as claimed in claim 2,  
wherein the end portions of the pressure absorbing member includes a second thick portion provided in a portion thereof.

11. (original) The recording head as claimed in claim 10, wherein the thick portion and the second thick portion of the pressure absorbing member have the same thickness.

12. (currently amended) The recording head as claimed in claim [[1]] 2, further comprising:

Kenichi OGATA et al., S.N. 10/530,607  
Page 7

Dkt. 2271/74228

a vibration plate forming at least one surface of the pressure-applied chambers,  
wherein a layer forms said vibration plate and at least a portion of the pressure absorbing member.

13. (currently amended) A line type recording head comprising a recording head as ~~claimed in claim 1~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber, along the predetermined direction, has a pressure absorbing surface with a rigidity lower than those of other wall surfaces and configured to absorb a pressure change,

wherein said pressure absorbing surface is formed by a pressure absorbing member having a non-uniform thickness, and

wherein the pressure absorbing surface is divided into a central portion and two end portions on both sides of the central portion along the predetermined direction, and an average thickness of the pressure absorbing member at the central portion is larger than an average thickness of the pressure absorbing member at the end portions.

Claim 14 (canceled).

Kenichi OGATA et al., S.N. 10/530,607  
Page 8

Dkt. 2271/74228

15. (currently amended) A line type recording head comprising a recording head as ~~claimed in claim 14~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles;

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers; and

a plurality of pressure converting means for varying pressures within the pressure-applied chambers,

at least one of the wall surfaces of the common chamber, along the predetermined direction, having a pressure absorbing surface with a rigidity lower than those of other wall surfaces and configured to absorb a pressure change,

said pressure absorbing surface being formed by a pressure absorbing member having a plurality of portions with different rigidities.

16. (currently amended) A carriage comprising:

a recording head ~~as claimed in claim 1~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the

Kenichi OGATA et al., S.N. 10/530,607  
Page 9

Dkt. 2271/74228

fluid to the pressure-applied chambers,  
wherein at least one of the wall surfaces of the common chamber, along the  
predetermined direction, has a pressure absorbing surface with a rigidity lower  
than those of other wall surfaces and configured to absorb a pressure change,  
wherein said pressure absorbing surface is formed by a pressure absorbing member  
having a non-uniform thickness, and  
wherein the pressure absorbing surface is divided into a central portion and two end  
portions on both sides of the central portion along the predetermined direction,  
and an average thickness of the pressure absorbing member at the central portion  
is larger than an average thickness of the pressure absorbing member at the end  
portions; and  
a fluid cartridge configured to supply the fluid to the recording head.

17. (currently amended) A carriage comprising:

a line type recording head as claimed in claim 14 including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and  
each communicating with a corresponding one of the nozzles;

a common chamber having a plurality of wall surfaces and configured to supply the  
fluid to the pressure-applied chambers; and

a plurality of pressure converting means for varying pressures within the pressure-  
applied chambers,



Kenichi OGATA et al., S.N. 10/530,607  
Page 10

Dkt. 2271/74228

wherein at least one of the wall surfaces of the common chamber, along the  
predetermined direction, has a pressure absorbing surface with a rigidity lower  
than those of other wall surfaces and configured to absorb a pressure change, and  
wherein said pressure absorbing surface is formed by a pressure absorbing member  
having a plurality of portions with different rigidities; and  
a fluid cartridge configured to supply the fluid to the recording head.

18. (currently amended) An image forming apparatus comprising:

a recording head ~~as claimed in claim 1~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and  
each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the  
fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber, along the

predetermined direction, has a pressure absorbing surface with a rigidity lower  
than those of other wall surfaces and configured to absorb a pressure change,

wherein said pressure absorbing surface is formed by a pressure absorbing member  
having a non-uniform thickness, and

wherein the pressure absorbing surface is divided into a central portion and two end  
portions on both sides of the central portion along the predetermined direction,  
and an average thickness of the pressure absorbing member at the central portion

Kenichi OGATA et al., S.N. 10/530,607  
Page 11

Dkt. 2271/74228

is larger than an average thickness of the pressure absorbing member at the end portions;

a fluid cartridge configured to supply the fluid to the recording head; and

a ~~cartridge~~ carriage, accommodating the recording head and the fluid cartridge, configured to move in a main scan direction which is perpendicular to the predetermined direction.

19. (currently amended) An image forming apparatus comprising:

a line type recording head as claimed in claim 1 including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and

each communicating with a corresponding one of the nozzles;

a common chamber having a plurality of wall surfaces and configured to supply the

fluid to the pressure-applied chambers; and

a plurality of pressure converting means for varying pressures within the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber, along the

predetermined direction, has a pressure absorbing surface with a rigidity lower

than those of other wall surfaces and configured to absorb a pressure change, and

wherein said pressure absorbing surface is formed by a pressure absorbing member

having a plurality of portions with different rigidities;

a fluid cartridge configured to supply the fluid to the recording head; and

Kenichi OGATA et al., S.N. 10/530,607  
Page 12

Dkt. 2271/74228

a ~~cartridge~~ carriage, accomnodating the recording head and the fluid cartridge,  
configured to move in a main scan direction which is perpendicular to the predetermined  
direction.

Claim 20 (canceled).

21. (currently amended) The recording head as claimed in claim ~~[[20]]~~ 23, wherein the  
pressure absorbing member has a continuous surface forming the damper surface.

22. (currently amended) The recording head as claimed in claim ~~[[20]]~~ 23, wherein the  
region is arranged on both ends of said at least one of the wall surfaces of the common chamber  
along the predetermined direction.

23. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 20 comprising:  
a plurality of nozzles for ejecting a fluid;  
a plurality of pressure-applied chambers arranged in a predetermined direction and each  
communicating with a corresponding one of the nozzles;  
a common chamber having a plurality of wall surfaces and configured to supply the fluid  
to the pressure-applied chambers; and  
a plurality of pressure converting means for varying pressures within the pressure-applied  
chambers, wherein:  
at least one of the wall surfaces of the common chamber, along the predetermined

Kenichi OGATA et al., S.N. 10/530,607  
Page 13

Dkt. 2271/74228

direction, has a damping surface with a rigidity lower than those of other wall surfaces and configured to absorb a pressure by vibration.

said damping surface is formed by a pressure absorbing member which partially has a region where no damping surface is formed, such that the damping surface extends for a length along the predetermined direction less than a total length of the common chamber along the predetermined direction.

at least a portion of wall surfaces forming the pressure-applied chambers has a rigidity lower than the other wall surfaces to form a vibration plate of the pressure converting means, and both the vibration plate and the damper surface are formed by a common first layer.

24. (original) The recording head as claimed in claim 23, further comprising:  
a second layer partially formed on the common first layer and forming the region,  
said common first layer extending in the predetermined direction and forming the damper surface by a surface thereof not having the second layer formed thereon.

25. (currently amended) The recording head as claimed in claim ~~[[20]]~~ 23, wherein the damper surface has an elasticity lower than those of the other wall surfaces of the common chamber.

26. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 20 comprising:  
a plurality of nozzles for ejecting a fluid;  
a plurality of pressure-applied chambers arranged in a predetermined direction and each

Kenichi OGATA et al., S.N. 10/530,607  
Page 14

Dkt. 2271/74228

communicating with a corresponding one of the nozzles;

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers; and

a plurality of pressure converting means for varying pressures within the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber, along the predetermined direction, has a damping surface with a rigidity lower than those of other wall surfaces and configured to absorb a pressure by vibration,

wherein said damping surface is formed by a pressure absorbing member which partially has a region where no damping surface is formed, such that the damping surface extends for a length along the predetermined direction less than a total length of the common chamber along the predetermined direction, and

wherein an elasticity  $G_d$  (Pa) of the pressure absorbing member forming the damper surface satisfies a relationship

$$1.0 \times 10^{-13} < L_x^{-1} \times L_{dx} \times L_{dy} \times T_d^{-0.3} \times G_d^{-1} < 2.0 \times 10^{-13}$$

where  $L_x$  (m) denotes a length of the common chamber along the predetermined direction,  $L_{dx}$  (m) denotes a length of the damper surface of the pressure absorbing member along the predetermined direction,  $L_{dy}$  (m) denotes a length of the damper surface of the pressure absorbing member along a direction perpendicular to the predetermined direction, and  $T_d$  (m) denotes a thickness of the pressure absorbing member forming the damper surface.

27. (currently amended) A carriage comprising:

Kenichi OGATA et al., S.N. 10/530,607  
Page 15

Dkt. 2271/74228

a recording head ~~as claimed in claim 20~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and

each communicating with a corresponding one of the nozzles;

a common chamber having a plurality of wall surfaces and configured to supply the

fluid to the pressure-applied chambers; and

a plurality of pressure converting means for varying pressures within the pressure-

applied chambers.

wherein at least one of the wall surfaces of the common chamber, along the

predetermined direction, has a damping surface with a rigidity lower than those of

other wall surfaces and configured to absorb a pressure by vibration.

wherein said damping surface is formed by a pressure absorbing member which

partially has a region where no damping surface is formed, such that the damping

surface extends for a length along the predetermined direction less than a total

length of the common chamber along the predetermined direction; and

a fluid cartridge configured to supply the fluid to the recording head.

28. (currently amended) An image forming apparatus comprising:

a recording head ~~as claimed in claim 20~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and

each communicating with a corresponding one of the nozzles;

Kenichi OGATA et al., S.N. 10/530,607  
Page 16

Dkt. 2271/74228

a common chamber having a plurality of wall surfaces and configured to supply the  
fluid to the pressure-applied chambers; and  
a plurality of pressure converting means for varying pressures within the pressure-  
applied chambers,  
wherein at least one of the wall surfaces of the common chamber, along the  
predetermined direction, has a damping surface with a rigidity lower than those of  
other wall surfaces and configured to absorb a pressure by vibration,  
wherein said damping surface is formed by a pressure absorbing member which  
partially has a region where no damping surface is formed, such that the damping  
surface extends for a length along the predetermined direction less than a total  
length of the common chamber along the predetermined direction;  
a fluid cartridge configured to supply the fluid to the recording head; and  
a ~~cartridge~~ carriage, accommodating the recording head and the fluid cartridge,  
configured to move in a main scan direction which is perpendicular to the predetermined  
direction.

Claim 29 (canceled).

30. (currently amended) The recording head as claimed in claim [[29]] 33, wherein a  
member forming the free vibration surface integrally forms a surface of the pressure-applied  
chamber.

Kenichi OGATA et al., S.N. 10/530,607  
Page 17

Dkt. 2271/74228

31. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 29 comprising:  
a plurality of nozzles for ejecting a fluid;  
a plurality of pressure-applied chambers arranged in a predetermined direction and each  
communicating with a corresponding one of the nozzles; and  
a common chamber having a plurality of wall surfaces and configured to supply the fluid  
to the pressure-applied chambers,  
wherein at least one of the wall surfaces of the common chamber has a free vibration  
surface having thick portions and thin portions, and  
wherein a member forming the free vibration surface has a stacked structure made up of a plurality of stacked layers.

32. (original) The recording head as claimed in claim 30, wherein the thick portions have a thickness equal to a thickness of a member forming a wall surface of the pressure-applied chamber.

33. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 29 comprising:  
a plurality of nozzles for ejecting a fluid;  
a plurality of pressure-applied chambers arranged in a predetermined direction and each  
communicating with a corresponding one of the nozzles; and  
a common chamber having a plurality of wall surfaces and configured to supply the fluid  
to the pressure-applied chambers,  
wherein at least one of the wall surfaces of the common chamber has a free vibration



Kenichi OGATA et al., S.N. 10/530,607  
Page 18

Dkt. 2271/74228

surface having thick portions and thin portions, and

wherein the thin portions are arranged in vicinities of a portion of the free vibration surface where a width of the free vibration surface along a direction perpendicular to the predetermined direction narrows compared to other portions.

34. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 29 comprising:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the fluid to the pressure-applied chambers.

wherein at least one of the wall surfaces of the common chamber has a free vibration surface having thick portions and thin portions, and

wherein the thin portions are arranged in vicinities of a portion of the common chamber where a cross sectional area of the common chamber cut along a direction perpendicular to the predetermined direction decreases compared to other portions.

35. (currently amended) ~~[[The]]~~ A recording head as claimed in claim 29 comprising:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the fluid

Kenichi OGATA et al., S.N. 10/530.607  
Page 19

Dkt. 2271/74228

to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber has a free vibration surface having thick portions and thin portions, and

wherein a cross sectional area of the common chamber cut along a direction perpendicular to the predetermined direction decreases towards an end portion of the common chamber along the predetermined reaction.

36. (currently amended) A carriage comprising:

a recording head ~~as claimed in claim 29~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and

each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the

fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber has a free vibration

surface having thick portions and thin portions, and

wherein the thin portions are arranged in vicinities of a portion of the free vibration

surface where a width of the free vibration surface along a direction perpendicular

to the predetermined direction narrows compared to other portions; and

a fluid cartridge configured to supply the fluid to the recording head.

37. (currently amended) An image forming apparatus comprising:

Kenichi OGATA et al., S.N. 10/530,607  
Page 20

Dkt. 2271/74228

a recording head ~~as claimed in claim 29~~ including:

a plurality of nozzles for ejecting a fluid;

a plurality of pressure-applied chambers arranged in a predetermined direction and

each communicating with a corresponding one of the nozzles; and

a common chamber having a plurality of wall surfaces and configured to supply the

fluid to the pressure-applied chambers,

wherein at least one of the wall surfaces of the common chamber has a free vibration

surface having thick portions and thin portions, and

wherein the thin portions are arranged in vicinities of a portion of the free vibration

surface where a width of the free vibration surface along a direction perpendicular

to the predetermined direction narrows compared to other portions;

a fluid cartridge configured to supply the fluid to the recording head; and

a ~~carriage~~ carriage, accommodating the recording head and the fluid cartridge,

configured to move in a main scan direction which is perpendicular to the predetermined direction.